Indian Standard   (Reaffirmed 2013)

SPECIFICATION FOR
OPTICAL BEVEL PROTRACTORS

1. Scope — Requirements for optical bevel protractors for general engineering purposes.

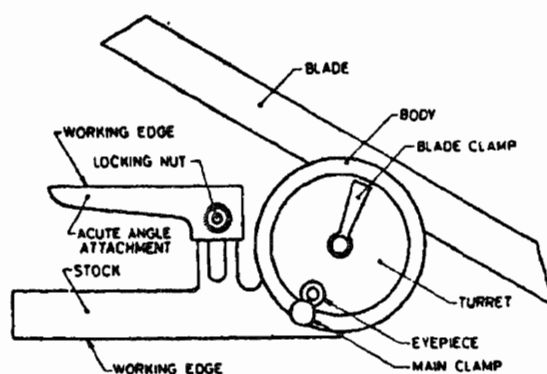**2. Nomenclature** — The nomenclature given in Fig. 1 shall apply.

FIG. 1   OPTICAL BEVEL PROTRACTOR

3. Construction — In the type of bevel protractors covered in this standard, provision is made for an internal circular scale which is graduated in divisions of 10 minutes of arc and read against a fixed index line or vernier by means of an optical magnifying system integral with the instrument, enabling readings to be taken by estimation or otherwise, to approximately 2 minutes of arc.

4. Material — The working parts of the bevel protractors shall be made of steel suitable for the purpose. Stainless steel may also be used if specifically required by the purchaser.

5. Hardness — The blade of the bevel protractors shall have a hardness of 650 to 700 *HV* [*see* 1501 - 1968 ' Method for Vickers hardness test for steel (first revision)].

6. Dimensions

6.1 *Stock* — The working edge of the stock shall be not less than 90 mm long and shall have a thickness of not less than 7 mm.

6.2 *Blade* — The blade shall be either 150 or 200 or 300 mm long, and shall be not less than 13 mm in width and not less than 2 mm in thickness.   The ends of the blade shall be bevelled to 60° and 45° as shown in Fig. 2.

FIG. 2   BEVELLING OF BLADE

6.3 *Scale* — The scale dial shall not be less than 65 mm and not more than 75 mm in diameter.

6.4 *Acute Angle Attachment* — The working edge of the acute angle attachment shall be   be less than 75 mm long and the thickness shall correspond to that of the blade.

Engineering Metrology Sectional Committee, EDC 43; Precision Measuring Equipment Subcommittee, EDC 43 : 2 [Ref : Doc : EDC 43 (1629)]

7. General Requirements

7.1 *Body* - The bevel protractor shall be so designed that the back of the body is flat and that there are no projections beyond the plane of the back of the bevel protractor. When the bevel protractor is placed on its back on a surface plate there shall be no perceptible rock.

7.2 *Blade* The blade shall be so designed that it is possible to move it along the turret throughout its whole length, and also be reversed. An effective method of clamping shall be provided.

7.3 *Acute Angle Attachment* – This shall be so designed as to fit readily on the body. It shall be capable of being clamped at any desired point, within the limit provided, in the base.

7.4 *Clamping* – Thumb nut or any other suitable clamping device shall be furnished for locking the turret to the body.

8. Accuracies

8.1 *Body* — When the bevel protractor is placed on the working edge of the stock on a surface plate and the blade set at 90°, the side of the blade and the back of the bevel protractor body shall be square laterally with the surface plate to within 0.03 mm per centimetre.

8.2 *Stock* — Any departure from true straightness of the working edge shall be in the nature of a concavity, the extent of which shall not exceed 0.01 mm, when measured over the total span of the surface concerned.

8.3 *Blade* – The accuracies for the blade shall be as per table below:

Size of Blade mm	Tolerance in Micrometres			Angular Tolerance for Bevelled Ends in Minutes of Arc
	Flatness of Blade	Straightness of Working Edge 3	Parallelism of Working Edges	
150	150	10	15	± 5
200	200	15	20	± 5
300	300	20	30	± 5

8.4 *Acute Angle Attachment* The working edge shall be straight to within 0.005 mm and according to the type of the attachment, shall be parallel with, or square to, the working edge of the stock to within 0.015 mm over the length of the attachment in all its positions.

8.5 *Error of Readings* – The total error of indication of an optical bevel protractor in any position of the blade shall not exceed ± 2 minutes of arc.

9. Graduations

9.1 The scale shall be graduated as a full circle marked 0 - 90 - 0 - 90 (four quadrants). The zero positions shall be indicated when the blade is parallel to the stock. The acute angle reading shall then be zero or 90° according to the type of acute angle attachment, when fitted.

9.2 All graduations shall be clearly defined. The thickness of the graduations of the scale and the vernier shall be equal, and between 1 and 2 minutes of arc, as observed through the optical system.

9.3 The scale and vernier shall be in focus in the optical system simultaneously.

9.4 Provisions shall be made for adjusting the focus of the system to accommodate normal variations in eyesight and the field of view shall be properly illuminated when the instrument is held to the light.

10. Finish — All exterior surfaces except knurled surfaces of the bevel protractors shall have a finish such that the surface roughness shall be 1 μm *Ra* value (*see* IS : 3073-1967 'Assessment of surface roughness') or better.

11. Designation — The optical bevel protractors shall be designated by the size of the blade and the number of the standard.

> *Example:*
>
> An optical bevel protractor with 150 mm blade shall be designated as:
>
> Bevel Protractor 150 IS : 5812

12. Tests

12.1 *Flatness* — The flatness shall be tested with a dial indicator (see IS : 2092-1962 'Specification for dial gauges') used in conjunction with a surface gauge and surface plate [see IS : 2285-1974 'Specification for cast iron surface plates (*first revision*)'] or by any other method of equal or greater precision.

12.2 *Squareness* — The squareness shall be determined with a dial indicator used in conjunction with surface plate and precision angle block [*see* IS : 2554-1971 'Specification for cast iron angle plates (*first revision*)'] or by any other method of equal or greater precision.

12.3 *Angular Intervals* – Angular intervals shall be determined by means of either a toolmaker's microscope, precision dividing head or dial indicator used in conjunction with a surface plate, sine bar (*see* IS : 5359-1969 'Specification for sine bars') and slip gauges (see IS : 2984-1966 'Specification for slip gauges') or by any other method of equal or greater precision.

12.4 *Parallelism* — The blades shall be tested for parallelism by means of micrometer (*see* IS : 2967 - 1964 'Specification for external micrometers') or by any other method of equal or greater precision.

12.5 *Straightness* — The plates shall be tested for straightness with straight edges (see IS : 2220-1962 'Specification for steel straight edges') of known accuracy or with a dial indicator and reference precision surface plates [*see* IS : 2285-1974 'Specification for cast iron surface plates *(first revision*)'].

13. Marking — Each bevel protractor shall have legibly and permanently marked upon it, in character is not less than 1 mm high, the nominal size of the blade, the accuracy of reading and manufacturer's name or trade-mark.

13.1 *ISI Certification Mark* — Details available from the Indian Standards Institution.

14. Packing — Each bevel protractor shall be coated with a suitable anticorrosive coating and shall be wrapped in a moisture-proof paper or any other suitable wrapping material. The bevel protractor shall then be applied in a suitable protective case.

EXPLANATORY   NOTE

Optical bevel protractors were formerly covered in IS : 4239-1967 'Specification for bevel protractors which has been revised and in the revision only mechanical bevel protractors are being covered Optical bevel protractors are, therefore, covered in the present standard. The requirements given in the present standard are identical with those covered formerly for optical bevel protractors in IS : 4239-1967 One more size of blade, that is, 200 mm, has been added.